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Applicant(s): John M. Miller

Serial No: 10/053,152 Group Art Unit: 2836

Filed: 01/23/2002 Examiner: Boris Benenson

Title: ELECTROMECHANICAL VALVE ASSEMBLY FOR AN INTERNAL COMBUSTION ENGINE

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APPELLANTS' BRIEF ON APPEAL

Sir:

Applicant respectfully submits that all claims on appeal have been finally rejected and therefore an appeal is in accordance with 37 CFR §1.191(a).

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I. Real Party in Interest

The real party in interest is the assignee, Ford Global Technologies, LLC, a corporation organized and existing by virtue of the laws of the State of Delaware, having its principal place of business in the City of Dearborn, County of Wayne, State of Michigan.

II. Related Appeals and Interferences

The Applicant, Applicant's legal representatives, and the Assignee are unaware of any ongoing appeals or interferences that will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. Status of Claims

Claims 22-33 were originally filed in this divisional application on January 23, 2002. In a response to the first office action dated August 14, 2002 applicants canceled Claims 22-33 and added new claims 34-49. In the final office action, dated February 13, 2003, Claims 34-49 were rejected. Applicant filed a Notice of Appeal on May 6, 2003.

Claims 34-49 are the claims at issue in this Appeal. No claims have been allowed. A list of pending claims is provided in the Appendix.

IV. Status of Amendments

No amendments have been filed in the present application subsequent to the final office action dated February 13, 2003.

V. Summary of Invention

The present invention relates to a method for current recirculation between first and second electromechanical valve assemblies in first and second engine cylinders, respectively. In particular, the method includes transferring electrical energy generated in the first electromechanical cylinder valve during closing of the first valve to a second electromechanical cylinder valve to open the second valve. Thus, the present invention allows the recirculation of electrical energy between the first and second electromechanical cylinder valves to conserve energy during the operation of the valves to increase engine efficiency.

VI. Issues Presented on Appeal.

The issues on appeal relate generally to the following:

(1) Has the Examiner failed to make a prima facie showing of obviousness in rejecting claims 34-38, 42-46 under 35 U.S.C. §103(a) based on a combination of Diehl and Ule, when (i) the Examiner has not identified any proper motivation in the references for the proposed combination, and (ii) the proposed combination does not teach all of the limitations of claims 34-38, 42-46?

(2) Has the Examiner failed to make a prima facie showing of obviousness in rejecting claims 39-41 under 35 U.S.C. §103(a) based on Diehl and Ule, when (i) the Examiner has not identified any proper motivation in the references for the proposed combination, and (ii) the proposed combination does not teach all of the limitations of claims 39-41?

(3) Has the Examiner made a prima facie showing of obviousness in rejecting independent claim 47 under 35 U.S.C. §103(a) based on a combination of Diehl and Ule, when (i) the Examiner has not identified any proper motivation in the references for the proposed combination, and (ii) the proposed combination does not teach all of the limitations of claim 47?

(4) Has the Examiner made a prima facie showing of obviousness in rejecting independent claim 48 and dependent claim 49 under 35 U.S.C. §103(a) based on a combination of Diehl, Reinicke, and Ueda, when (i) the

Examiner has not identified any proper motivation in the references for the proposed combination, and (ii) the proposed combination does not teach all of the limitations of claims 48-49?

VII. Grouping of Claims

Applicant groups the claims as follows:

1. Claims 34-38, 42-46 stand or fall together.
2. Claims 39-41 stand or fall together.
3. Claim 47 stands or falls by itself.
4. Claims 48-49 stand or fall together.

VIII. Argument

A. The Examiner's rejection of Claims 34-38, 42-46 under 35 U.S.C. §103(a) is improper.

The Examiner's rejection of Claims 34-38, 42-46 under 35 U.S.C. §103(a) is improper because the Examiner has failed to identify any proper motivation for the combination of Diehl and Ule, and (ii) the proposed combination fails to teach all the limitations of Claims 34-38, 42-46.

I. No motivation to combine Diehl and Ule.

Before proceeding with Applicant's analysis, a brief description of Diehl and Ule will be provided. Referring to Diehl, an electromechanically actuated valve assembly 18 is disclosed that utilizes three electromagnets (22, 30, 32) to actuate a valve 12. Diehl further indicates that the valve is "an electromechanically actuated engine valve having variable valve timing and lift which is capable of operating at the speeds required by internal combustion engine operation." See column 2, lines 27-30. Further, Diehl teaches that "utilizing the resonance of the two springs in the actuator 18 to accomplish much of the movement, response time is improved over merely providing electromagnets, and with less power consumption." See column 4, lines 62-65.

Referring to the secondary reference Ule, a solid state switching circuit is described for actuating two solenoids. See Figure 5. In particular, Ule indicates that "when two solenoids are being operated alternately as is often the case, for example, to achieve a bidirectional mechanical motion or to control a three-way solenoid valve, the energy of one electromagnet being energized can be used to produce the

high voltage to energize the second electromagnetic at high speed without the aid of a separate high voltage source." See column 5, lines 49-55. Further, Ule teaches that the circuit can operate in an "either-or" mode where only one of the two electromagnets is energized, but not both. See column 6, lines 35-36.

Applicant will now explain why the Examiner has failed to identify proper motivation for the combination. Referring again to Diehl, the reference purports to provide a valve capable of operating at speeds required by internal combustion engines. Thus, the Diehl system would not need a faster rate of valve opening or closing as proposed by the Examiner. Further, Diehl indicates that it already has less power consumption by utilizing the two biasing springs. Thus, the Examiner's identified motivation for modifying Diehl with Ule (i.e., opening closing the valves at a faster rate and saving energy) is not found in Diehl because Diehl already purports to address these issues. Thus, Applicant submits that the Examiner has not identified any proper motivation for the combining Diehl and Ule.

Further, even if the combination of Diehl and Ule were attempted, the combined teachings of the references would not result in a workable system. As discussed above, the electromechanically actuated valve 12 described in Diehl utilizes three electromagnets (22, 30, 32). Referring to Figure 5 of Ule, a circuit is described that actuates two solenoids 35, 36. Ule, however, provides no teaching of how this circuit could recirculate current between two separate electromechanical cylinder valves each having three electromagnets (as utilized in Diehl) that would result in an operating engine. Further, Diehl does not address the

recirculating current between multiple electromechanical cylinder valves in an engine. Thus, even if the teachings of Diehl and Ule were combined, the combination would not result in a workable system.

II. The proposed combination of Diehl and Ule does not teach all of the limitations of claims 34-38, 42-46.

The rejection of Claims 34-38, 42-46 under 35 U.S.C. §103(a) based upon Diehl and Ule is improper because the proposed combination does not teach all of the limitations of the claims. Referring to independent Claim 34, for example, the claim recites:

> *A method for controlling an engine, comprising:*
>
> *transferring electrical energy generated in a first electromechanical exhaust valve during closing of said first valve to a second electromechanical cylinder intake valve to open said second valve.*

Neither reference, alone or in combination, provides any teaching of transferring electrical energy between an electromechanical engine cylinder valve that is closing to a second electromechanical engine cylinder valve that is opening. Thus, the proposed combination fails to teach the recited limitations of Claim 34 and of Claims 35-38, 42-46 that recite similar limitations.

Further, Applicants submit that Examiner's assertion that a controller would inherently recirculate current between two electromechanical engine cylinder valve assemblies when closing one assembly and opening another assembly is completely unsupported. Applicant has been unable to find any such teaching in either reference. Therefore, Applicant

submits that the cited references do not teach all the limitations of Claims 34-38, 42-46.

B. The Examiner's rejection of Claims 39-41 is improper

As discussed above in Section A, the Examiner has not identified any proper motivation for the combination of Diehl and Ule in rejecting claims 34-38, 42-46. Similarly, this argument applies equally to claims 39-41.

Further, even if the teachings of Diehl and Ule were combined, the proposed combination fails to teach all of the limitations of independent claims 39-41 as will be discussed below.

Referring to claim 39, the claim recites:

> *A method for controlling an engine, comprising:*
>
> *recirculating a current generated in a first electromechanical cylinder exhaust valve while decelerating said first valve towards a closed position to a second electromechanical cylinder intake valve to open said second valve.*

Independent claims 40-41 recite similar limitations.

Referring to Diehl, the reference fails to provide any teaching of recirculating a current generated in a first electromechanical cylinder exhaust valve while decelerating the first valve towards a closed position to a second electromechanical valve to open the a second electromechanical valve. Further, Ule does not provide any teaching of recirculating current from a decelerating first electromechanical cylinder valve to a second electromechanical valve. Thus, even if the references are combined, the proposed combination fails to teach all of the limitations of Claims 39-41.

C. The Examiner's rejection of Claim 47 is improper.

The Examiner's rejection of independent Claim 47 is improper because the Examiner has not identified any proper motivation for the proposed combination of Diehl and Ule as discussed above in Section A. Further, the proposed combination fails to teach all of the limitations of Claim 47.

I. Referring to Claim 47, the claim recites:

> *A method for controlling an engine, comprising:*
>
> *generating a current in the first ball-screw valve assembly communicating with a first engine cylinder while decelerating said first valve assembly towards a closed position; and*
>
> *directing said current to a second ball-screw valve assembly communicating with a second engine cylinder to induce said second valve assembly to move towards an open position.*

Referring to Diehl and Ule, neither reference teaches the step of generating a current in a first ball-screw valve assembly communicating with a first engine cylinder while decelerating the first valve assembly towards a closed position. This is evident, since neither reference describes a first ball-screw valve assembly. Further, neither reference describes directing current to a second ball-screw valve assembly as required by the second step of Claim 47. The Examiner indicated in the final office action that the mechanical design of the valve is not essential and ball-screw design of the valve should have no effect on patentability of the method. Applicant respectfully disagrees, since the limitations of generating a current in the first ball-screw

valve assembly and directing said current to a second ball-screw valve assembly are explicit limitations of the claim. Thus, Applicants submit that neither reference teaches the recirculating current between two ball-screw valve assemblies as recited in Claim 47.

D. The Examiner's rejection of Claims 48-49 is improper.

The Examiner's rejection of Claims 48-49 is improper under 35 U.S.C. §103(a) because (i) the Examiner has failed to show proper motivation for combining the three references, Diehl, Reinicke, and Ueda, and (ii) the proposed combination does not teach all of the claimed limitations.

I. No motivation to combine Diehl, Reinicke, Ueda.

As discussed above, Diehl describes a valve assembly that utilizes three electromagnets to actuate an electromechanical engine valve. Referring to Reinicke, the reference discloses use of a ball-screw assembly utilized to move a poppet valve relative to a valve seat to control high pressure fluid flow through a conduit.

After carefully reviewing Diehl, however, Applicant can find no teaching, or hint of any teaching, that it would be desirable for the electromagnets (22, 30, 43) to be replaced by the ball-screw mechanism of Reinicke. Nor has the Applicant been able to find any such teaching in Reinicke.

The Examiner stated in the final office action that it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the electromechanical valve of Diehl to use a motor to drive the valve as taught by Reinicke because this allows control of an engine by controlling the valve position, valve dwell time duration, valve opening and closing rate.

As discussed above, however, Diehl purports to operate at speeds necessary for operation of an internal combustion engine. Thus, Diehl provides no teaching that it would be beneficial to further control the dwell time duration or the valve opening and closing rate. Further, Reinicke provides no such teaching. Further, the Diehl system already controls the valve position as discussed above and thus already accomplishes this task without any modification thereto. Thus, Applicant submits that the Examiner has failed to provide any proper motivation for combining Diehl and Reinicke.

Applicant will now explain why there is no motivation to further combine Ueda with Diehl and Reinicke. As shown in Ueda, an automatic string winder for winding string on a drum is disclosed. The string winder includes motors M1-M2n having motor winders U1-U2n driven by inverters I1-I2n. Inverters I1-12n are connected via lines L1-L2n to an AC/DC converter 3. Further, the motors M1-M2n rotate unidirectionally to allow string to be wound on drums adjacent corresponding motors.

Referring to Figure 2, Ueda utilizes a triangular signal 5 to iteratively accelerate and decelerate the odd number motors M2n-1 while such motors continue to rotate in the same direction. Similarly, a triangular signal 7 is used to iteratively accelerate and decelerate the even numbered motors M2n while such motors continue to rotate in the same direction. The signals 5, 7 are out of phase with respect to one another so that the even numbered motors are accelerated while the odd numbered motors are decelerated, and vice versa. See Ueda, column 2, lines 57-65. The regenerative

energy generated in the decelerating motors is used in the accelerating motors. See Ueda, column 3, lines 2-8.

Now, lets assume that the teachings of Ueda were somehow applied to Diehl and Reinicke. As discussed above, Ueda teaches controlling a motor to obtain unidirectional rotation, while accelerating and decelerating the motor rotation. If this methodology were applied to Reinicke, the rotor 31 would be iteratively accelerated and decelerated toward an open position (or a closed position) until poppet valve 14 could no longer move any further axially. Thus, utilizing the methodology of Ueda with the Reinicke ball-screw mechanism would either lock the poppet valve 14 in a closed position or lock the valve in an open position indefinitely. In other words, since Ueda only teaches unidirectional control, this control methodology would not work on an electromechanical engine cylinder valve, which requires directional control in two directions (e.g., upwardly and downwardly). Accordingly, the combined teachings of Diehl, Reinicke, and Ueda would result in an unworkable system for an internal combustion engine. Thus, because the proposed combination would result in an unworkable system for an engine, Applicant submits that no motivation exists for the proposed combination.

II. The combination of Diehl, Reinicke and Ueda fail to teach all of the limitations of Claims 48-49.

Even if the teachings of Diehl, Reinicke and Ueda were combined, the combination fails to teach all of the limitations of Claims 48-49. Referring to Claim 48, the claim recites:

A system for controlling valve operation in an engine, comprising:

a first control circuit coupled to a first electromechanical valve, said first valve controlling fluid communication with a first engine cylinder; and

a second circuit coupled to a second electromechanical valve, said second valve controlling fluid communication with a second engine cylinder, wherein a current generated in said first valve while decelerating said first valve towards a closed position is routed through said first control circuit to said second control circuit to induce said second valve to move towards an open position.

Neither Diehl nor Ueda teach utilizing first and second control circuits for controlling first and second electromechanical engine valves, respectively, during opening and closing of the valves. Nor does Diehl and Ueda teach routing the current generated in the first engine valve while decelerating the valve towards a closed position to a second valve moving towards an open position, as recited in Claim 48. Thus, Applicant submits that the proposed combination fails to teach all of the limitations in independent claim 48 and dependent claim 49.

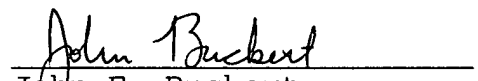
IX. Conclusion

Applicant respectfully submits that the Examiner has failed to establish a *prima facie* showing of obviousness in rejecting Applicant's Claims 34-49 under 35 U.S.C. § 103. In particular, Applicant submits that the Examiner has failed to provide any proper motivation for the proposed combinations and that the proposed combinations fail to teach all of the claimed limitations.

Accordingly, Applicant requests the Board of Appeals to reverse the rejection of the appealed claims by the Examiner and to hold allowable all appealed claims under consideration in the application.

This Appeal Brief is being submitted in triplicate. Please charge Deposit Account 06-1510 the statutory fee, including filing fees and extension fees, required for filing this document as required by 37 CFR 1.17.

Respectfully submitted,



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Appendix A: Claims on Appeal

34. A method for controlling an engine, comprising:

transferring electrical energy generated in a first electromechanical cylinder exhaust valve during closing of said first valve to a second electromechanical cylinder intake valve to open said second valve.

35. The method of claim 34 wherein said transferring step includes:

generating a current in said first electromechanical cylinder exhaust valve while decelerating said first valve towards a closed position; and,

routing said current to said second electromechanical cylinder intake valve to induce said second valve to move towards an open position.

36. The method of claim 34 wherein said first and second valves communicate with first and second engine cylinders, respectively.

37. A method for controlling an engine, comprising:

transferring electrical energy generated in a first electromechanical cylinder exhaust valve during closing of said first valve to a second electromechanical cylinder exhaust valve to open said second valve.

38. A method for controlling an engine, comprising:

transferring electrical energy generated in a first electromechanical cylinder intake valve during closing of said first valve to a second electromechanical cylinder intake valve to open said second valve.

39. A method for controlling an engine, comprising:

recirculating a current generated in a first electromechanical cylinder exhaust valve while decelerating said first valve towards a closed position to a second electromechanical cylinder intake valve to open said second valve.

40. A method for controlling an engine, comprising:

recirculating a current generated in a first electromechanical cylinder exhaust valve while decelerating said first valve towards a closed position to a second electromechanical cylinder exhaust valve to open said second valve.

41. A method for controlling an engine, comprising:

recirculating a current generated in a first electromechanical cylinder intake valve while decelerating said first valve towards a closed position to a second electromechanical cylinder intake valve to open said second valve.

42. A method for controlling an engine, comprising:

reversing a flow of current in a first electromechanical valve communicating with a first engine cylinder when said first valve is being closed; and,

directing said current to a second electromechanical valve communicating with a second engine cylinder to induce said second valve to move towards an open position.

43. The method of claim 42 wherein said step of reversing said flow of current occurs when said first valve is being decelerated towards a closed position.

44. The method of claim 42 wherein said first valve is a cylinder exhaust valve and said second valve is a cylinder intake valve.

45. The method of claim 42 wherein said first valve is a cylinder exhaust valve and said second valve is a cylinder exhaust valve.

46. The method of claim 42 wherein said first valve is a cylinder intake valve and said second valve is a cylinder intake valve.

47. A method for controlling an engine, comprising:

generating a current in the first ball-screw valve assembly communicating with a first engine cylinder while decelerating said first valve assembly towards a closed position; and,

directing said current to a second ball-screw valve assembly communicating with a second engine cylinder to induce said second valve assembly to move towards an open position.

48. A system for controlling valve operation in an engine, comprising:

a first control circuit coupled to a first electromechanical valve, said first valve controlling fluid communication with a first engine cylinder; and,

a second circuit coupled to a second electromechanical valve, said second valve controlling fluid communication with a second engine cylinder, wherein a current generated in said first valve while decelerating said first valve towards a closed position is routed through said first control circuit to said second control circuit to induce said second valve to move towards an open position.

49. The system of claim 48 wherein said first and second electromechanical valves are electrically actuated ball-screw valves.